

Analysis of Radiological Accuracy Among Different Intraoperative Imaging Systems for Screw Fixation in Cervicothoracic Region

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Purpose: The aim of this study was to compare the accuracy of posterior subaxial cervicothoracic fixation using 3 different techniques: intraoperative CT (iCT-AIRO) scanner-guided navigation, 3-dimensional (3D) (O- arm) based spinal navigation, and fluoroscopy based posterior stabilization.

Methods: In the period between August 2007 and October 2018, a total of 495 screws were implanted in 67 patients with cervicothoracic instability who underwent posterior fixation. 163 screws were inserted with the use of the iCT-based spinal navigation (group A), 310 screws were implanted using the O-arm navigation system (group B), while 22 screws were inserted under the guidance of fluoroscopy (group C). Screw positions were evaluated using postoperative CT scans according to the Neo et al. (cervical pedicles) and Gertzbein and Robbins (thoracic) classifications. The screws in the cervical lateral mass were evaluated according to a new classification created by the authors. The assessment of the screw placement was retrospectively done and graded by an independent observer. Accurate positioning was defined then as screws that were correctly placed completely within the pedicle as well as screws with a breach of less than 2 mm or screws that were correctly placed within the lateral mass as well as screws with incomplete perforation of the cortex.

Results: Intraoperative CT-based navigation has permitted a more accurate intraoperative evaluation of the implanted screws and has allowed the immediate correction of misplaced screws. With the use of the iCT, the accuracy rate has reached 97.55% with a much better resolution of the images acquired, while with the O-arm navigation, the accuracy rate has reached 90%. In cervicothoracic posterior stabilizations done with the aid of fluoroscopy, the intraoperative accuracy was not determined and only a final accuracy rate was measured, which reached 90%. The most significant difference in accuracy was in the positioning of cervical pedicle screws. Our results have demonstrated an accuracy of 96% with iCT compared to an accuracy of 64% with the O-arm. The accuracy rates in positioning the cervical lateral mass screws and the thoracic pedicle screws with both the iCT or the O-arm were almost the same.

Conclusion: In subaxial cervicothoracic posterior fixation, especially of pedicle screws, the use of iCT-based spinal navigation has demonstrated higher accuracy rates as well as higher quality images allowing more accurate evaluation than with the O-arm-based spinal navigation or fluoroscopy based systems.